Winter 12-19-2001

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Chyan Yang

Yu Chao

Pei Chao

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Chyan Yang[1], Yu Chao[2,3], Pei Chao[4]

[1]Institute of Business & Management, National Chiao Tung University, Taiwan

[2]Department of Management Science, National Chiao Tung University, Taiwan

[3]Department of Business Administration, Chung Hua University, Taiwan

[4]Business Workflow Development Section, Office Information Technology Department, TSMC

EMAIL: professor_yang@hotmail.com

ABSTRACT

With the rapid growth of internet there are about fifty thousands of users get access to the internet in Taiwan area. Given the consensus of internet service providers (ISP's) that soon will reach seventy-five thousands within two years. This would imply that the users of traditional dial up modems will be facing serious insufficient bandwidth problems. To make the problem worse, the internet applications are moving toward multimedia which always eats up bandwidth faster than expected. Moreover, to join WTO forces Taiwan to relinquish its telecom market to international players. These new players sure will jump into the broadband market. This research is to investigate the household consumers' satisfaction in Hsinchu area on the broadband networking. The findings pointed out that important demographic variables affecting satisfaction are gender, age, education, and vocation. Additionally, dimensions of customers' satisfaction do have a negative correlation with customers' satisfaction. This is to say that when the higher the degree of a concern the lower the customer satisfaction. In general, expected service levels are always higher than that really experienced.

INTRODUCTION

Based on the statistic released from III (Institute of Information Industry) there are about fifty thousands of users get access to the internet in Taiwan area. ChungHwa telecom has the statistic from its subsidiary, the Hinet, indicates that the size soon will reach seventy-five thousands within two years. Meanwhile, the users of traditional dial up modems will be facing serious insufficient bandwidth problems. This is just due to the rapid growth of number of users. It also seriously affected by the multimedia applications on the internet that require much higher bandwidth than before. Moreover, to join WTO forces Taiwan to relinquish its telecom market to international players. These new players sure will jump into the broadband market. The internet service providers (ISP's) sure have a need to understand the customers' satisfaction to position its own marketing strategy.

Based on the survey of NetValue (October 2000), population broadband accessing rates vary a lot around the globe. Korea has the highest ratio of household broadband accessing rate of 38% meaning more than one third of its population get access to broadband networking services. Other countries with different rates are Hong Kong (7.6%)、France(6.8%)、United States(6%)、Singapore(4.0%)、Germany(3.2%)、Taiwan(1.9%)、China(0.1%). This profile of broadband access rates indicates that Taiwan is entering the era of broadband access to internet. In Taiwan area, the two main types of broadband access are ADSL (Asymmetric Digital Subscriber Line) and cable modem. Therefore, in this research the term 'broadband' represents the collective usage of ADSL ad cable modem. Besides, we focus our study on the household users and not including the enterprise users for broadband access. From the observation on the growth of internet access in Taiwan, broadband ISP's sure will be interested in knowing the customers' satisfaction to ensure their market shares. Customers' behavior is sure a must item for the formulating the corporate strategy in deploying net products and services.

The objectives of this research are to investigate the impact of demographic variables on customers' satisfaction, to understand the concerns and the satisfaction of broadband users. Findings of the research can be a good reference to ISP's.

LITEATURE REVIEWS

The definition of so-called broadband is depending on whom you talked to. In this research we adopt the generally accepted definition that the transmission rate is higher than 1.544Mbps (Northern American) or 2.048 Mbps (Europe). There are four major types of broadband technologies, the ISDN (Integrated Service Digital Network), Direct PC, ADSL (Asymmetric Digital Subscriber Line), and Cable Modem. Since we focus this research on the household users therefore we limited ourselves in ADSL and cable modem accesses when speaking of broadband.

Based on the personal communications with ISP's, by the end of November 15th, 2000 the size of cable modem users was around 80 thousands and was a little bit higher than

that of ADSL(around 66 thousands). However, the lower installation of ADSL was due to the shortage of ADSL modems since the number of names waiting list of ADSL applications was more than 40 thousands. ChungHwa Telecom is the largest service provider of 56 thousands.

ADSL

The key to the usage of ADSL is its nature of asymmetric transmission rates of upstream and downstream to the internet access. This asymmetric nature perfectly matches the normal use of household applications: people generally key in a few words on the web browser and waiting to download bunch of information for reference. The higher rate of downloading internet files as oppose a lower transmission rate of uploading a user's command is exactly the need of a typical user. Besides, ADSL technology uses traditional copper telephone wires, or POTS (Plain Old Telephone Systems). Since the phone lines in Taiwan has a better coverage than that of cable TV's ADSL becomes a better choice. Moreover, ADSL can directly use the phone line system without deploying a separate line to a user's apartment or house it enjoys a cheaper installation charge than that of cable modem. Unless one already has a cable installed, most people will choose ADSL over the cable modem. Note that IDC also predicts that ADSL will me the mainstream for future data storage services.

For broadband ISP's, there are two main ADSL products in the market: one directly from ChungHwa Telecom, the HiFly and the indirect HiFly acess from other ISP's. HiFly service needs an ADSL modem (sometimes people might call it ADSL router) which allows a user to keep his phone line open without interruption of internet access. The upstream transmission rate is around 64k~~640kbps while the downstream transmission rate at 512k~~6Mbps. Other ISP's might actually use high speed ATM (Asynchronous Transmission Mode) technology (transparent to users) with HiFly as the last connection part to provide an ADSL service. Seednet and many other ISP's are providing this 'ADSL equivalent' service to their users.

Cable Modem

Most ISP's that provide cable modem services are those cable TV companies. However, the business of cable TV companies are not of concern in this study. The so-called cable modem uses coaxial cable that transmits cable TV programs to establish internet access by using an access device, the cable modem. Two major players of ISP's that provide cable modem access to internet are the Giga Networking and ET Home.

Table 1: A comparison of ADSL and Cable Modem [Yang2000]

	User's cost	Fixed IP addresses	Bandwidth requirement	Installation requirement	Best for
ADSL	Medium to high	Up to 5	Medium to high	Must be within 4KM to switch	Small office with high bandwidth needs
Cable Modem	Low to medium	None	Low to medium	Do not support too many users on same cable	Personal workshop, household office

Customers' Satisfaction

Generally speaking, literature usually discuss customers' satisfaction by either scope or properties. When scope is used to describe customers' satisfaction, researchers focus on the feeling of specific transactions or the overall feelings. [5,8,9,18]. Those who use the property to define the satisfaction treat the satisfaction as the process of cognition evaluation or the emotional reaction after having used the product. This is an integrated overall evaluation [11,15,16]. Table 2 summarizes representative theories on customers' satisfaction. Since this study is to investigate the difference between the 'degree of concerns before using the broadband services' and 'the real experiences after having used the broadband services', we adopt the 'Expectancy and Disconfirmation' as the basic conceptual framework.

Some researchers used "overall satisfaction" to measure satisfaction [6,7], the others used "multiple items" to measure satisfaction [13,14]. But most of researches used both. Two frequently used methods are (1) linear combinations of perception attributes in regression analysis. (2) satisfaction of each attribute in regression analysis to investigate relationships among attributes.

For understanding the main reasons of customers' satisfaction and un-satisfaction, the research objects are broadband users and use multiple item to measure the satisfaction. Because the ISPs are one of information service industry, the measuring dimensions of satisfaction are service marketing mix [1], those are product, price, channel, promotion, physical equipment, service personnel, service process. The measuring items of satisfaction are referenced from investigating of web users.

The types of measuring customers satisfaction are simple satisfaction scale, mixed scale, expectational scale, attitude scale, affect scale [4]. We use the mixed scale where "satisfied" and " dissatisfied" mark at both ends of the continue spectrum of s atisfaction scale.

METHODOLGY

The conceptual research framework is shown in Figure 1. This research investigates the customer satisfaction of broadband connections in Hsinchu area. Because the main broadband connections in Taiwan are ADSL and Cable modem therefore the scope of "broadband" in this research covers only these two types of connections. The research objects are family users. The hypotheses to be tested are listed below.

H1: The demographic variables are irrelevant to customer satisfaction.

H2: The degree of concerns on dimensions of customers' satisfaction are irrelevant to customer satisfaction.

H3: The customers' degree of concern has no significant

difference from that of customers' real experiences.

The questionnaire consists of four parts. The first part covers demographic items: gender, age, education level, occupation, and average personal income per month. The second part is the customers' degree of concern on product, price, place, promotion, physical equipment, personnel, and process. The third part is the customers' degree of concern on unused broadband connection. The fourth part is the level of satisfaction that customers' real experiences of using broadband connections. The measure uses five points Likert scale.

We assume that the population of this research is normally distributed. Since demographic variables are all of nominal or categorical, one can use ANOVA to test whether these variables have impact on customers' satisfaction. When investigating the relationship between the "customer's degree of concern" (independent variable X) and "overall customers satisfaction" (dependent variable Y) one can use simple regression analysis. When testing the difference between "customers' real experiences" and "customers' degree of concerns" one can use pair-wise t-test. This is because that the degree of concern expressed the perception before using the broadband services whereas the real experiences are after using the services.

Sampling design and questionnaire collecting

Since customers name lists are kept confidential for most ISP services. However, we only got from ISP that the number of ADSL and Cable modem users in Hsinchu area were about 800 and 1,600, respectively (at the end of November, 2000). A stratified sampling method according to proportion of ADSL and Cable modem users are 33% and 67%(ADSL=800/2400=33%, Cable modem=1600/2400=67%). Thereafter, with convenience sampling we sent 300 questionnaires to broadband users. A total of 238 questionnaires were returned to the researchers with valid samples of 201. Table 2 summaries the demographic characteristics of these samples. Note that the personal income is lower than reasonable. This might due to conservative culture in disclosing one's wealth in Taiwan. Moreover, students are of majority in the survey. This might bias the overall picture toward young students.

RESULTS

We use the internal consistency method to assure the reliability. Listed in Table 3 are the Cronbach's α values showing the reliabilities of the survey. Notice that all dimensions regarding degree of concerns have Cronbach's α values larger than 0.6 therefore the measures reliable [Guielford 1965]. The overall reliability is as high as 0.9560. The reliability measures of customer satisfaction are all of 0.6 or higher except the product dimension. The overall reliability of customer satisfaction is 0.8861. In short, the whole survey is reliable.

The analysis of variation (ANOVA)

We used ANOVA to test whether demographic variables have impact on customers' satisfaction. The analysis shows that the average personal income per month has no statistically significant effect. Gender, age, education, occupation do have statistically significant difference (shown in Table 4).

The analysis of variation about demographic variables and the customer satisfaction dimensions

Table 5 shows significant items, marked with it, between demographic variables and customer satisfaction dimensions. Note that personal income does not affect dimensions of customer satisfaction.

Simple linear regression analysis

In this section, we investigated the relationship between the "overall customers' degree of concern" and "overall customers' satisfaction". We computed the score and rank of overall customers' degree of concern. The highest degree of concern is on the price item that has a total score of 1069. The least weight is given to "promotion" which has a total score of 581. We then applied simple regression analysis to find the relationship. In the regression analysis, these seven factors are used as predictor variables whereas the customers' satisfaction is the dependent variable. The results presented in Table 7 and Figure 2.

The coefficient of determination $r2 = 0.653$, F value=9.43, p=0.2778 (shown in Table 7). Because p value<0.05, the overall customers' degree of concern and overall customers satisfaction have statistically significant difference. These dimensions can interpret the 65.3% degree of variance. Figure 2 shows that the linear of seven factors and overall customers' satisfaction are near to negative slope. This is to say that the higher the degree of a concern the lower the customer satisfaction. The most concern factor of customers is "price". Price is the highest customer satisfaction. The least concern factor of customers is "promotion". Promotion is the lowest customer satisfaction. This observation suggests that H2 should be rejected.

The analysis of pair-wise t- test

From the questionnaire, we got the data of the difference between customer's experience of using broadband connection and the degree of concern before using. Then we compute the mean, standard error and pair-wise t-test. The analysis results are shown in Table 8.

Note that the items of low t-values are 8,3,9,6,4 (in increasing order) which indicate customers are satisfied with. They are advertisement promotion, convenience place of payment, convenience place of application, the effective line speed, and product features announced. On the other hand, items of high t-values are 18,2,10,19,13 (in decreasing order). These are items that customers are

dissatisfied with. They are the quality and reliability of modems, ISP quickly response to handle complaint, security and privacy of data transferring network, reliable network communications, connection fees.

Table 9 lists the order the group sum of values by dimension from low to high. It shows that the "promotion" is the most satisfactory dimension whereas the "price" is the least one. The overall t-value is 4.634438. Table 10 is the mean rank of customers' satisfaction items. The mean ranks of customer's satisfaction are promotion, channel, Service personnel, physical equipment. The observation shows that the satisfaction really experienced is lower than that of expected or degree of concerns. Note that the t-values are high enough to reveal this. When $p<0.1$ indicates significant difference, one can conclude that most items exhibit significant difference except the item of "convenience location of payment". Therefore one should reject H3. One possible reason that can support our findings might be that the broadband services are at the early stage of the product life cycle hence many basic features of the services are not mature and not stable to meet customers' needs.

CONCLUSIONS

Demographic variables such as gender, age, occupation, and education level do have impact on the satisfaction of broadband access. The seven dimensions that measure customers' satisfaction account for 65.3% explanation to the variance of customers' satisfaction. Moreover, this study reveals that the degree of concerns before using the broadband services is inverse proportional to the satisfaction after real experiences. This seems true that a high desire for an immature product or service might lead to low satisfaction.

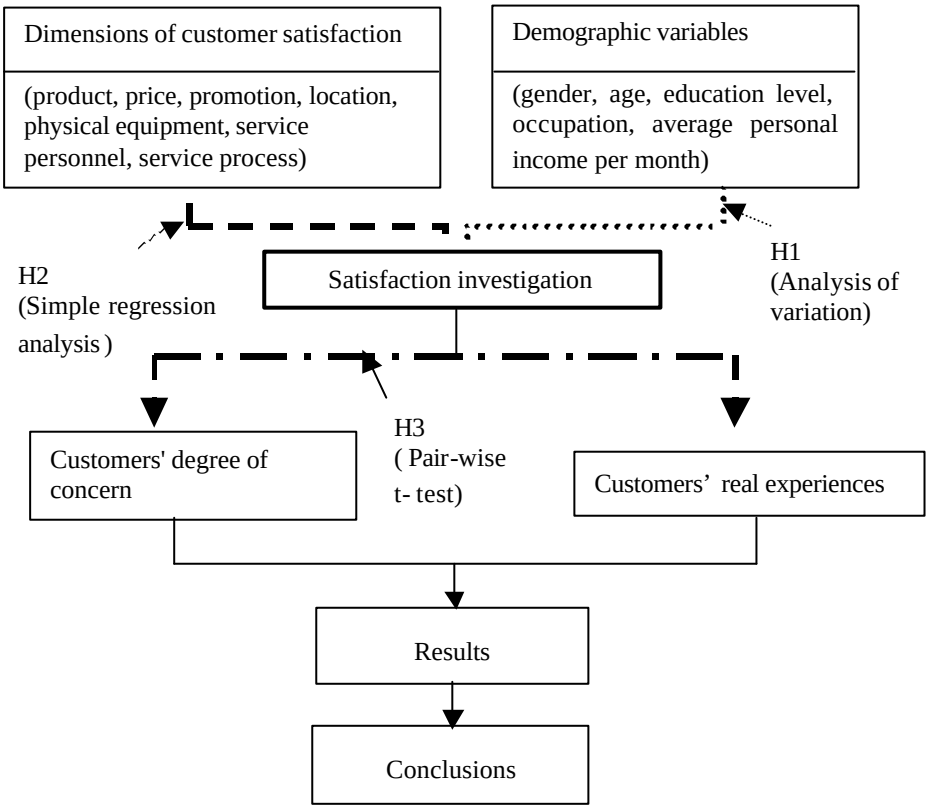

Figure 1 Conceptual framework

Table 2 Descriptive Statistic

Gender	Male	Female				
%	54	46				
Age	Under 20	21~30	31~40	41~50	51~60	Above 60
%	21	61	15	3	0	0
Education	Elementary school	Junior high school	Senior high school	Junior college	University	Graduate school
%	1	0	11	31	54	3
Occupation	Engineer	Businessman	The military, public official, teacher	Farmer, fisherman, herdsman	Student	Other
%	13	14	8	0	49	16
Income (NT$)	Under 50000	50001~ 100000	100001~ 150000	150001~ 200000	Above 200000	
%	86	13	1	0	0	
The type of connection	ADSL	Cable modem				
%	33	67				

Table 3 Reliabilities

Dimensions	Customers' degree of concern Cronbach's α	Customers real experience Cronbach's α
Product	0.8620	0.3539
Promotion	0.6830	0.6971
Personnel	0.8391	0.7138
Physical equipment	0.6668	0.8678
Channel	0.7831	0.7339
Process	0.7946	0.7053
Price	0.8335	0.7382
Overall	0.9560	0.8861

Table 4 Table of significant between demographic variables and customer satisfaction items (marked with ∗)

Variables / item	Gender	Age	Occupation	Education	Average personal income per month
1				*	
2				*	
3				*	
4					
5	*		*		
6		*		*	
7					
8		*		*	
9	*				
10					
11					
12					
13					
14					
15	*				
16	*				
17	*				
18	*				
19	*				
20	*				
21	*		*		

Remark:
1. ISP can remove connection problem rapidly.
2. Reliable network communications. (no noise, un-interrupt, etc.)
3. Convenience location of payment
5. Service personnel are knowledgeable to deal with customers.
6. The effective line speed.
7. Customers will not wait impatiently for services.
8. Advertisement promotion
9. Convenience location of application
15. Friendly services.
16. The ease of using equipment.
17. The breakdown rate of channels equipment.
18. Connection fees.
19. ISP quickly response to handle complain.
20. Promotion programs of ISP.
21. ISP is flexible in meeting customers' need.

Table 5 Table of significant items between demographic variables and customer satisfaction dimensions (marked with ∗)

Demographic Variables / Dimensions Of Customer Satisfaction	Gender	Age	Occupation	Education Level	Average Personal Income Per month
Service Process		∗	∗	∗	
Product		∗		∗	
Channel					
Promotion		∗			
Service Personnel	∗				
Price		∗			
Physical Equipment	∗				

Table 6 Score and rank of overall customers satisfaction

Rank	Dimensions	Score
1	Price	1069
2	Product	919
3	Physical equipment	906
4	Channel	786
5	Service Process	758

6	Service Personnel	619
7	Promotion	581

Table 7 ANOVA of customers' degree of concern and overall customers satisfaction

ANOVA						
Model		Sum of squares	df	Average sum of squares	F	p
1	Regression	117763.9	1	117736.9	9.425668	0.02778
	Residual	62469.8	5	12493.96		
	Total	180233.7	6			

Table 8 Pair-wise t-test (N=201)

Dimension	item	Mean	Standard error	t	p
Product	2.Reliable network communications (no noise, un-interrupt, etc.)	0.8358	1.7429	6.7986	1.08E-10
	6.The effective line speed	0.5024	2.7388	2.6010	0.009986
	10.Security and privacy of data transferring network	0.57213	1.1983	6.7689	1.27E-10
Promotion	4.Product features announced	0.2288	1.1778	2.7546	0.006417
	8.Advertisement promotion	-0.1393	1.1534	-1.7121	0.088410
	20.Promotion programs of ISP	0.4129	1.3467	4.3471	2.19E-05
Personnel	5.Service personnel are knowledgeable to deal with customers	0.4328	1.4165	4.3318	2.34E-05
	7.Customers will not wait impatiently for service	0.4626	1.5066	4.3539	2.13E-05
	15. Friendly services	0.2786	1.1009	3.5879	0.000419
Physical Equipment	13.The failure rate	0.6318	1.3652	6.5615	3.92E-10
	16.The ease of using equipment	0.3283	1.1754	3.9604	0.000103
	17.The breakdown rate of channels equipment	0.6019	1.5168	5.6266	6.15E-08
Channel	3.Convenience location of payment	0.0646	1.0003	0.9165	0.360464
	9.Convenience location of application	0.1840	1.1317	2.3058	0.022141
	12.Convenience location of maintians	0.5174	1.2086	6.069	6.36E-09
Service Process	1.ISP can remove connection problem rapidly	0.5323	1.3748	5.4894	1.21E-07
	19.ISP quickly response to handle complain	0.6815	1.4690	6.5778	3.59E-10
	21.ISP is flexible in meeting customers' need	0.4676	1.1662	5.6849	4.59E-08
Price	11.modem rental fee or purchasing price	0.6218	1.4022	6.2876	2.01E-09
	14.Installation fees	0.5870	1.3833	6.0166	8.37E-09
	18.Connection fees	0.8656	1.5352	7.9943	8.88E-14

Note：Assume mean of population=0，that is no difference.

Note：$t_{\alpha/2}(\alpha=0.1$ degree of freedom 200)=1.645 ~ $Z_{\alpha/2}(\alpha=0.1)$

Note：Sample statistic t is used for measuring satisfaction.

Note：Paired t value = (mean of sample-0)/(standard error/$\sqrt{201}$). If the paired t-test value is positive, that item has unsatisfaction. If the paired t-test value is negative, that item has satisfaction.。

Table 9 t-value rank of overall customers' satisfaction

Dimension	Sum of t value	Rank
Promotion	5.389604	1
Channel	9.29149	2
Service personnel	12.27378	3
Physical equipment	16.14869	4
Product	16.16869	5
Service process	17.75234	6
Price	20.29861	7

Note：t value is used to measure testing satisfaction.

Table 10 Mean Rank of Customers' Satisfaction dimension

Dimension	Sum of Mean	Rank
Promotion	0.502488	1
Channel	0.766169	2
Service personnel	1.174129	3
Physical equipment	1.562189	4
Service process	1.681592	5
Product	1.910448	6
Price	2.074627	7

Table 11 Overall Mean of customers' degree of concern and real experiences

Dimensions	Items	Mean a	Mean b
Product	2.Reliable network communications (no noise, un-interrupt, etc.)	3.89	3.05
	6.The effective line speed	3.79	3.29
	10.Security and privacy of data transferring network	3.78	3.2

Promotion	4.Product features announced	3.22	3
	8.Advertisement promotion	2.97	3.1
	20.Promotion programs of ISP	3.4	2.99
Service personnel	5.Service personnels are knowledgable to deal with customers	3.52	3.09
	7.Customers will not wait impatiently for services	3.51	3.04
	15.Friendly services	3.5	3.22
Physical equipment	13Failure rate of modems	3.85	3.22
	16The ease of using equipment	3.57	3.24
	17.The breakdown rate of channels equipment	3.77	3.16
Channel	3.Convenience location of payment	3.35	3.29
	9.Convenience location of application	3.37	3.19
	12.Convenience location of maintains	3.65	3.13
Service process	1.ISP can remove connection problem rapidly	3.69	3.16
	19.ISP quickly response to handle complain	3.74	3.06
	21.ISP is flexible in meeting customers' need	3.54	3.07
Price	11.modem rent or purchasing fees	3.63	3.01
	14.Installation fees	3.68	3.09
	18.Connection fees	3.77	2.91
Overall		3.580476	3.119524

Note：a is degree of concern, b is real experiences

Note：a-b=3.580476-3.119524=0.460952, that is overall mean in Table 18。

Note：Customer satisfaction is real experiences minus degree of concern.

ACKNOWLEDGEMENT

Thanks to students of department of business administration, Chung Hua university, Miss Gan, Miss Chen, Miss Ma, Miss Chen, and Mr. Chen, Mr. Chun. This research is possible due to their assistance in collecting questionnaire and materials.

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